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CONTENT ANALYSIS SILICA (SiO2) IN PROCESS WATER DETERMERALISATION WITH 4M METHOD

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ABSTRACT

This study aimed to analyze whether demineralized water is appropriate or not with the standards and also look for the cause of demineralized water quality parameters are not in accordance with the standards set by the company. Demineralized water is used as boiler feed water into the main ingredient manufacture of steam and very dangerous if water quality parameters exceed the prescribed standards. Sampling the data and methods used for the analysis of water quality with 4M method. 4M method is a method of analyzing the causes of a problem with categorizing the causes into four (Empat) factors: Man, Material, Method and Machine. The results of this study indicate that the index of the ability of the process to phase in the process of Strong Base Anion (SBA), Mixed Bed (MB) and Tank that the process capability index is below one, Cpk ≤ 1 means that the ability of the production process is less well demineralized water, where the water quality demineralized on the stages of the production process beyond the control of the gold standard parameter company. From the analysis that the problem parameters 4M silica (SiO2) in the process of demineralized water is not in accordance with the standards that are caused by factors is the most dominant factor that method on how to care machines and other facilities that should be done periodically .

***Keywords** : Silica (SiO2), Quality Control, 4M Analysis, Boilers.*

1. INTRODUCTION

Utility Department at PT. Asia Pacific Fibers Tbk, producing high-pressure steam, steam serves as a support in the production process at the PTA, Fiber and Polymer Department. High pressure steam is produced using Boiler HRSG (*Heat Recovery Steam Generator*) .

In the process of making the vapor pressure is referred to as the industry is Steam. Pressurized steam is obtained from the process water heating, tools for producing pressurized steam called Boiler or industry term called Boiler. The main raw material for the manufacture of pressurized steam is called the boiler feed water is demineralized water.

Demineralized water is water without minerals or very little mineral content obtained from the demineralization process through anion and cation resins. Boiler feed water is demineralized water were added chemicals. The use of demineralized water as a raw material boiler feed water is to keep the boiler and steam pipes are not experiencing corrosive dealer (*rust*) and Scale (*crust*) that occurs on the inside of the boiler and steam pipes dealer.

In the demineralization process takes several stages of the process that aims to eliminate harmful anions and cations, one example of anion - anion which is harmful to the boiler is silica (SiO2). Silica can cause pipes - pipes through which steam and water may stain which can lead to blockages - blockage in the pipe.

2. 4M ANALYSIS

The main goal of 4M analysis is to reduce losses in the company by taking into account all of the components that exist on the system (Man, Methods, Machinery and Materials). Stages of 4M Analysis methods include :

1. Defining the problem
2. Translation of an existing problem into several categories .
3. Prioritization and the principal settlement of the problem

Stages of defining the problem :

1. Selection Many diagnostic process to be evaluated, such as : systems, equipment, work area.
2. The development of the existing problems.
3. Identify the cause of each 4M into fishbone.

4M Analysis performed after each of the questions had been submitted to the existing problems that have relevance to the effects of the problems that have been registered in the sub categories 4M to be a priority and look for problem solving.

The usefulness of using 4M Analysis, namely :

1. Making sure we do not get out of the settlement boundary problem lies.
2. Making sure we find all the potential arising from problems or loss.
3. Describe the experience and also from some input from team members.
4. Development of kemunginan of the future of the settlement of a problem can be applied.

Analysis 4M method is achievement of a systematic approach to ensure what we find in all of the potential that can cause harm so that we can predict the likelihood of successful completion.

2.1. Process Capability Analysis

Analysis of the ability of the process is a step that should be done in the conduct statistical process quality control. This analysis is also a study to assess the ability of the process in the form of probability distributions that have a shape, average and deployment.

Implementation of process capability analysis is performed when the process in statistical control limit (deviation due to a common cause), if identified any specific cause, then the process capability analysis is stopped and performed corrective action against a combination of machines, tools, methods, materials, and related employees.

Analysis of the ability of the known existence of the limits. Specification limits are determined based on customer requirements, also called tolerance limits . Analysis of the ability to distinguish the process of compliance with the limits of tolerance. How to make the process capability analysis, among others :

2.2. Process capability ratio

Process capability ratio (Process Capability Ratio, PCR) or process capability index (Process Capability Index , Cp).

where Is :

USL = Upper Specification Limit

SL = Lower Specification Limit

6σ = six standard deviations

From the results of these calculations if:

Cp > 1 process is still good (*capable*)

Cp < 1 the process is not good (not capable)

Cp = 1 the same process with the customer specification

2.2.1. Index Process Capability

On process capability index (KPA) is the ratio of above-average range, while the lower process capability index (CDE) is the ratio of the average range below RKP, KPA and CDE is used to evaluate the limits prescribed specifications and evaluate process performance relative to the specification limits.

where Is :

CPU = ratio of above-average range

CPL = ratio of below-average range

3σ = 3 standard deviations

= Average process

d2 = the value of the table estimating factors

2.2.2. Indek Kemampuan Proses (Cpk Indek)

This process capability index measures the ability of potential, with no attention to the condition of the average process. On average the process assumed to be equal to the midpoint of the limits and the process is in statistical control conditions. In fact the average value is not always in the middle, so it needs to know the variety and location of the process mean. Cpk value represents the true power of a process with the specified parameters.

Where if :

Cpk 1, then the process is called good (capable)

Cpk 1, then the process is not good (not capable)

Cpk value shows the true power of the process with the values of the parameters. If the average value equal to the value of the actual center, then the actual value of Cpk = Cp values. The higher the index the greater the ability of the few products that are outside the specification limits.

3. RESEARCH METHODOLOGY

a. Identify the problem
Identification of the problem is the stage sharpening focus problems. It is done to reveal the initial problems Happens place the Basis for Further Research The research done husband . Problems found in demineralized air Production Process That QUALITY The air demineralized TPU NOT WITH Company standards.

b. Data Collection and Processing
Data collection and processing to classify data that can support the process capability analysis thus finding irregularities in the process of water quality demineralized water are the main cause. These data were also collected to be able to support in finding a solution to the problem. Troubleshooting using the method in which 4M Analysis using why - why analysis. Collecting data in this study is done in a way that :
- Direct observation of the research object.
- Noted secondary data available in the company.
- Reading administrative reports, as well as company -related reference data is needed.
- Conducting interviews with the parties in the company to obtain information diperukan to support discussion in the research object.

c. Analysis and Solutions
Data processing and analysis with 4M Analysis method is to categorize the factors issues into categories Man, Machine, Methods, and Materials. Then, after the discovery of the most dominant issue, the next use. Fishbone diagram to 4M with the elaboration of aspects of each sub- category of the 4M. If the source of the problem has been found on the main aspects of the sub categories, which can be done proposed improvement plan to improve the quality of demineralized water.

4. RESULTS AND DISCUSSION

The data will be taken based on the results of the laboratory PT. Asia Pacific Fibres that every day the sample was sent and analyzed as a report each day. So that water quality can be maintained and quickly take precautions when water quality as a result there is a boiler feed water analysis beyond the range, namely product SBA (Strong Base Anion).

a. Water Analysis SBA

Tabel Silica SBA (ppm)					Tabel Silica SBA (ppm)				
No	Tanggal	Shift 1	Shift 2	Shift 3	No	Tanggal	Shift 1	Shift 2	Shift 3
1	01/08/2014	0,05	0,06	0,01	16	16/08/2014	0,11	0,01	0,05
2	02/08/2014	0,05	0,05	0,11	17	17/08/2014	0,05	0,12	2,10
3	03/08/2014	0,03	0,57	0,09	18	18/08/2014	0,03	0,13	0,01
4	04/08/2014	0,05	0,05	0,08	19	19/08/2014	0,04	0,14	0,04
5	05/08/2014	0,08	0,08	0,02	20	20/08/2014	0,13	0,12	0,43
6	06/08/2014	0,06	0,04	0,04	21	21/08/2014	0,04	0,05	0,11
7	07/08/2014	0,06	0,07	0,10	22	22/08/2014	0,01	0,09	0,05
8	08/08/2014	0,04	0,03	0,01	23	23/08/2014	0,04	0,82	0,07
9	09/08/2014	0,17	0,01	0,02	24	24/08/2014	0,10	0,05	0,02
10	10/08/2014	0,03	0,03	0,02	25	25/08/2014	0,05	0,05	0,05
11	11/08/2014	0,03	0,02	0,05	26	26/08/2014	0,22	0,05	0,02
12	12/08/2014	0,05	0,07	0,10	27	27/08/2014	0,01	0,02	0,04
13	13/08/2014	0,04	0,04	0,03	28	28/08/2014	0,03	2,78	0,05
14	14/08/2014	0,05	0,13	0,07	29	29/08/2014	0,03	0,03	0,03
15	15/08/2014	0,01	0,07	0,04	30	30/08/2014	0,10	0,09	0,47

Calculate :

a. Chart $\overline{X}$; $\overline{X}$ = 0,13

UCL = $\overline{X}$ + (A2 . $\overline{R}$)
UCL = 0,13 + (1,023 X 0,28)
= 0,4156

LCL = $\overline{X}$ – (A2 . $\overline{R}$)
LCL =0,13 - (1,023 X 0,28)
= - 0,149125778

b. Chart $\overline{R}$, $\overline{R}$ = 0,28

UCL = D4 . $\overline{R}$
= 2,574 X 0,28
= 0,710

LCL = D3 . $\overline{R}$
= 0 X 0,28
= 0

In the analysis data of the table there are some data that is beyond the control limits, the data on the sample removed. And can be seen in Figure 1.

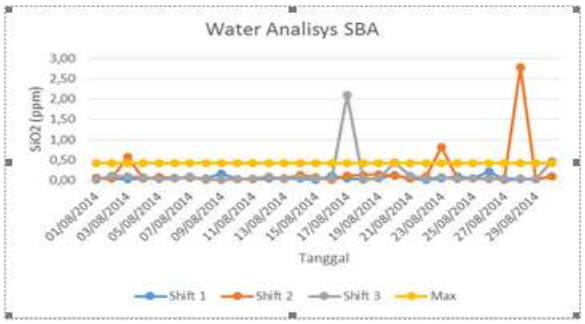

Figure 1. Water Analysis SBA

And after analyzing the data disposal out of range (distribution).

Table 1. Silica (SiO2) for SBA

Tabel Silica SBA (ppm)											
No	Tanggal	Mean	Max	Min	R	No	Tanggal	Mean	Max	Min	R
1	01/08/2014	0,04	0,06	0,01	0,05	13	14/08/2014	0,08	0,13	0,05	0,08
2	02/08/2014	0,07	0,11	0,05	0,06	14	15/08/2014	0,04	0,07	0,01	0,06
3	04/08/2014	0,06	0,08	0,05	0,03	15	16/08/2014	0,06	0,11	0,01	0,10
4	05/08/2014	0,06	0,08	0,02	0,06	16	18/08/2014	0,06	0,13	0,01	0,12
5	06/08/2014	0,05	0,06	0,04	0,02	17	19/08/2014	0,07	0,14	0,04	0,10
6	07/08/2014	0,08	0,10	0,06	0,04	18	21/08/2014	0,07	0,11	0,04	0,07
7	08/08/2014	0,03	0,04	0,01	0,03	19	22/08/2014	0,05	0,09	0,01	0,08
8	09/08/2014	0,07	0,17	0,01	0,16	20	24/08/2014	0,06	0,10	0,02	0,08
9	10/08/2014	0,03	0,03	0,02	0,01	21	25/08/2014	0,05	0,05	0,05	0,00
10	11/08/2014	0,03	0,05	0,02	0,03	22	26/08/2014	0,10	0,22	0,02	0,20
11	12/08/2014	0,07	0,10	0,05	0,05	23	27/08/2014	0,02	0,04	0,01	0,03
12	13/08/2014	0,04	0,04	0,03	0,01	24	29/08/2014	0,03	0,03	0,03	0,00

And calculate the data after the data out of range discarded. calculation :

a. Chart $\overline{X}$

$\overline{X}$ = 0,05

UCL = $\overline{X}$ + (A2 . $\overline{R}$)

UCL = 0,05+(1,023 X 0,06)

= 0,117

LCL = $\overline{X}$ – (A2 . $\overline{R}$)

LCL = 0,05 - (1,023 X 0,06)

= - 0,008

b. Chart $\overline{R}$

$\overline{R}$ **=** 0,06

UCL = D4 . $\overline{R}$

= 2,574 X 0,06

= 0,158

LCL = D3 . $\overline{R}$

= 0 X 0,06

= 0

c. Process Capability Index

$$Cp = \frac{USL - LSL}{6S}$$

$$S = \sqrt{\frac{(Nx\sum Xi^2) - (\sum Xi)^2}{N(N-1)}}$$ atau

$S = R/d_2$

S = 0,06 / 1,693 = 0,036

$$Cp = \frac{0{,}117 - (-0{,}008)}{6(0{,}036)} = 0{,}577$$

Calculate index Cpk :

Cpk = Minimum { CPU ; CPL }

Where is :

$$CPU = \frac{USL - X}{3S}$$ and

$$CPL = \frac{X - LSL}{3S}$$

$$CPU = \frac{0{,}117 - 0{,}05}{3(0{,}036)} = 0{,}577$$

$$CPL = \frac{0{,}05 - (-0{,}008)}{3(0{,}036)} = 0{,}577$$

Cpk = (0,577 ; 0,577)

Assessment criteria:

- If Cpk = Cp, then the process is against the
- If Cpk = 1, then the process resulted in a product that meets specifications
- If Cpk < 1, then the process produces a product that is not in accordance with specifications
- Because Cp > 1.00 then the process capability is low and less than the maximum output

Conclusion that the production process of the boiler feed water at SBA stage unfavorable, where the parameters of SiO2 (silica) does not match the specified parameters. After processing the data, then analyzed by the method of 4M.

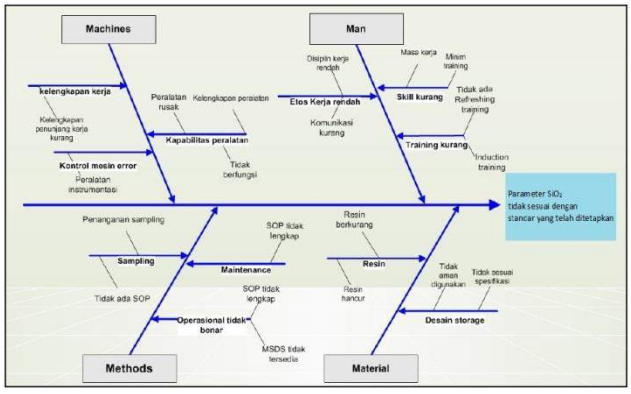

Figure 2. Diagram of fish bones

And after analyzing the last 4m done proposed improvements are :

1. Man

- Provide regular training on how to work and improved handling machinery / equipment in stages demineralized water production process, how to treat them to increase the quality of demineralized water.
- Provide an understanding of the spirit of labor discipline and are committed to continuous quality improvement (Continuous Improvement).
- Coordinated with field operators when there is work to avoid errors when performing regeneration information (regular maintenance)

2. Method

- Updating SOP according to the capability of machinery / equipment And provides a complete SOP, detailed and clear. Perform the work in accordance with the SOP.
- Setting up the MSDS (Material Safety Data Sheet) a complete and clear so that the operator can understand and work safely.
- To monitor the production (demineralised water) on a regular basis, such as monitoring the flow to the optimum for long tool conditions.
- Perform maintenance resin (material with regeneration or alkaline rinse) periodically.

3. Machinery / equipment

- Replacing the engine or equipment that has been damaged and do maintenance for machinery or equipment that serves to guarantee the quality of demineralized water production process in accordance with standards established by the company .
- Provide a work supporting equipment, such as personal protective equipment is complete, so that the operator can work safely and smoothly

4. Material

- Perform repairs or modifications to the storage of raw materials that are safe when used.
- exact chemical composition / fit the requirements.

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